

# Shared SPectrum Access for Radar and Communications (SSPARC) COMMDAR Project Overview

Michael Zatman

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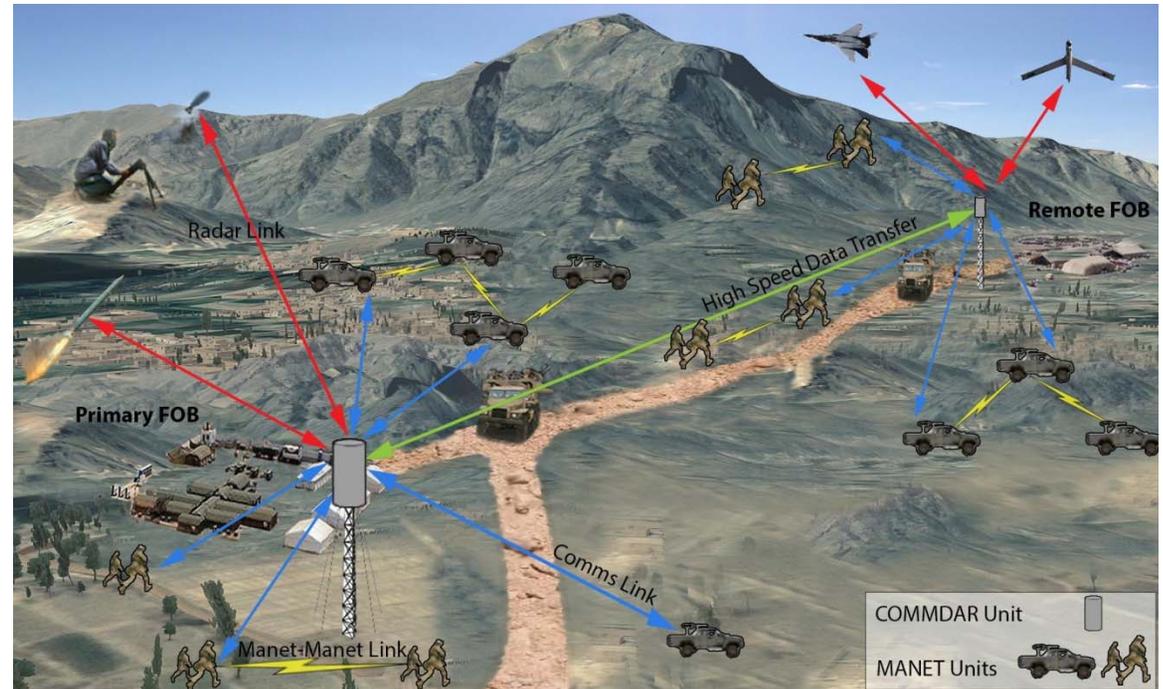
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# COMMDAR Mission: FOB Protection

- Forward Operating Bases (FOBs) have low power radars and MANETs working in the same vicinity.
- COMMDAR combines radar and MANET base station functionality.
- Mission consists of several radar and communications functions:



## Communications Functions:

1. Base station operation. Operating like a cellular base station to extend the MANET's range.
2. COMMDAR to MANET high data rate comms. Relaying information among commanders and the deployed forces, e.g. live video feeds from a UAV.
3. COMMDAR to COMMDAR high data rate comms. Relaying information between 'nearby' FOBs.

## Radar Functions:

1. Counter rocket, artillery and mortar (CRAM). Warning of incoming rounds and point of origin information for counter-fire.
2. Air Surveillance. Detecting and tracking aircraft, manned and unmanned, especially low-flyers not picked up by regional air-surveillance systems.
3. Ground surveillance. Monitoring nearby traffic.

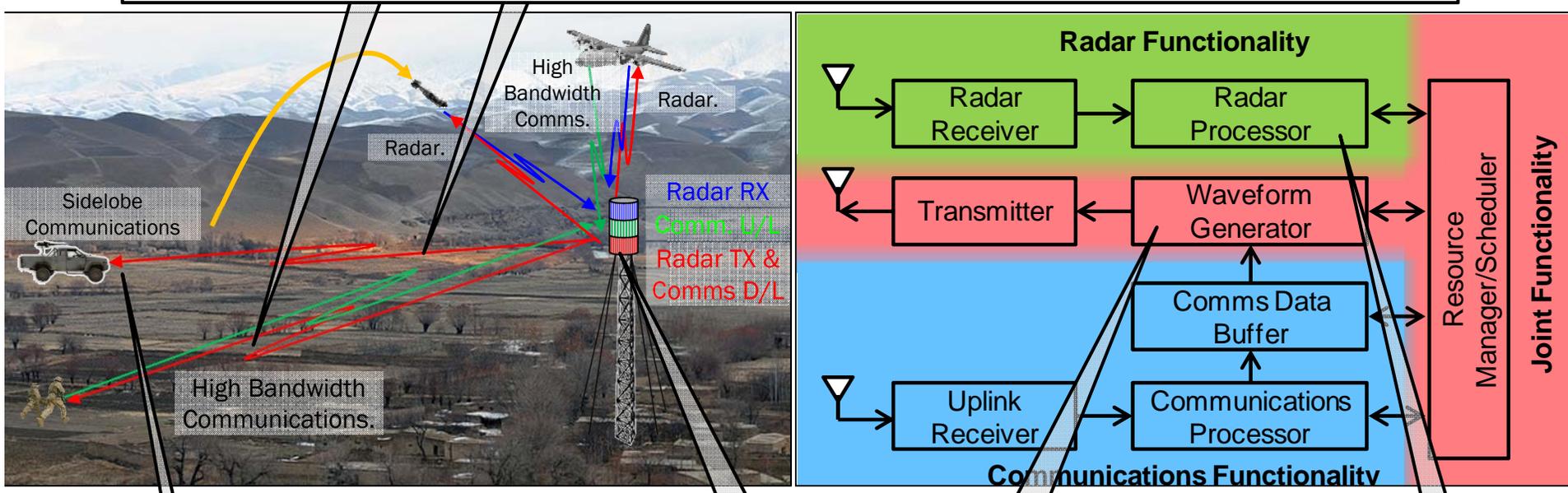
COMMDAR Reuses The Same Spectrum For All The Mission's Functions



# COMMDAR System Description

**COMMDAR:** A synergistic system combining radar and cellular/land-mobile base station techniques so that the communications downlink and radar waveform are completely integrated, providing 100% spectrum access to both.

**MIMO COMMDAR:** The intersection of MIMO communications and MIMO radar enables the COMMDAR system to communicate with more radios while simultaneously searching for targets.



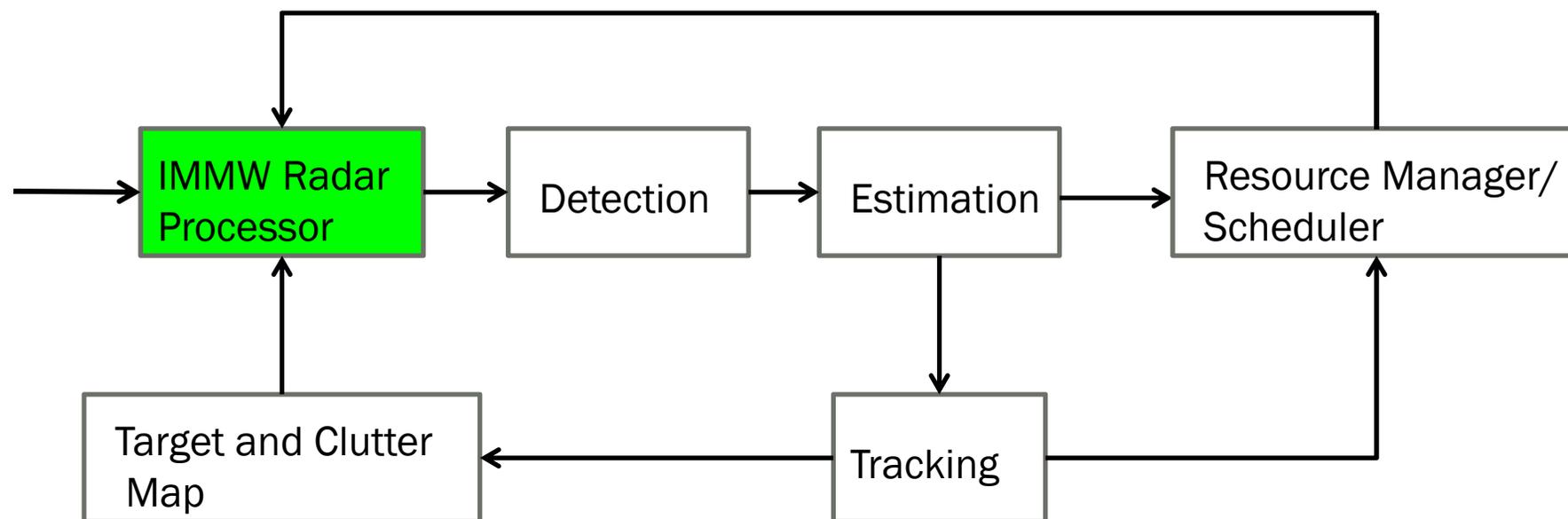
**Sidelobe Communications:** Making maximum of time the COMMDAR is not pointing at MANET radios to ensure that QoS requirements are met.

**Integrated Multi-Mode Waveform (IMMW):** Jointly optimized waveform for high data rate communications and radar whose (practically) unambiguous nature resulting in improved radar performance.

**IMMW Radar Processor:** Adaptive pulse-compression and Doppler processing techniques that ensure large targets and strong clutter do not degrade radar performance.



# Radar Processor

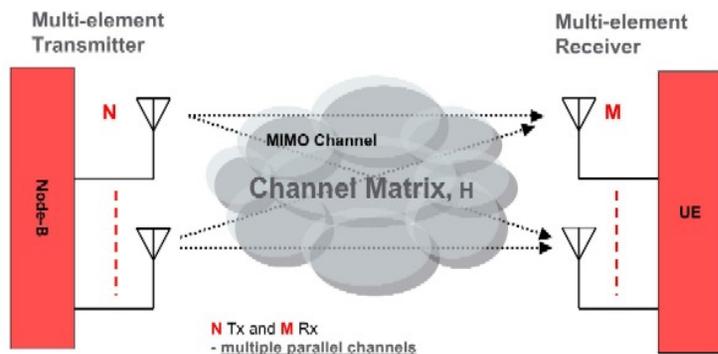


- Most radar functions are the same as a conventional radar
  - Detection, estimation, tracking
- IMMW Radar Processor contains COMMDAR unique filtering
  - Pulse compression, Doppler processing, clutter suppression
  - Computational complexity much higher than current radar systems, but still feasible in the latest FPGAs

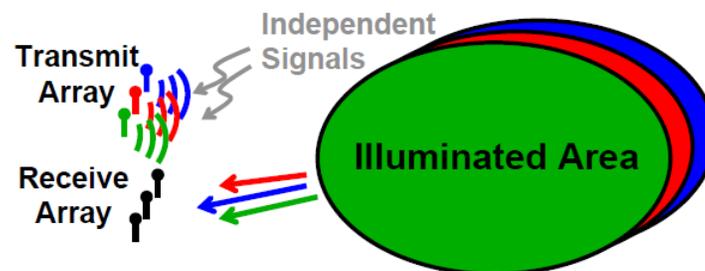


# MIMO COMMMDAR

## MIMO Communications



## MIMO Radar



- MIMO Communications

- Higher data rates in multipath scenarios by exploiting multiple spatial channels

- MIMO Radar

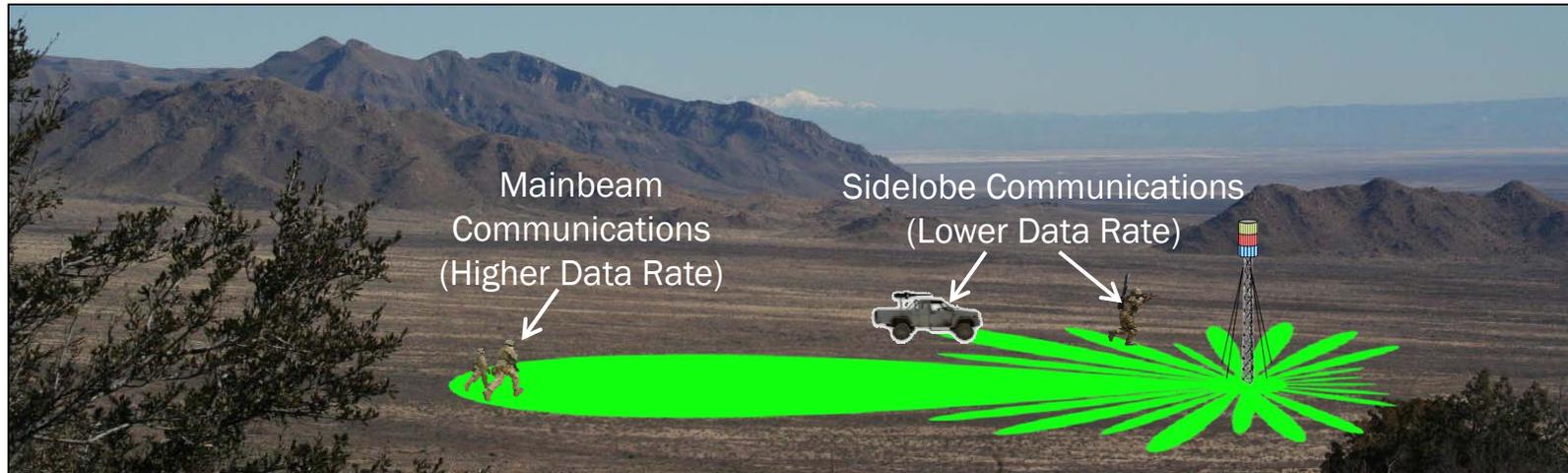
- Same sensitivity and search rate as non-MIMO radar for search
- Narrower effective receive beamwidth

- MIMO COMMMDAR

- Retains individual benefits of MIMO Radar and MIMO Communications
- Synergistic benefit of higher average data rates
  - Wider transmit beam means each radio is illuminated for longer by the COMMMDAR



# Sidelobe Communications



- In most scenarios it is likely that COMMDAR will spend much of the time pointing away from the MANET users.
- Communicating through the transmit sidelobes (at lower data rates) enables low latency and better QoS for many low-data rate applications such as voice, text and network control.
- Each bit of information may be spread over multiple modulation symbols (like CDMA / DSSS) to make up for the lost antenna gain.
- Ensures 100% spectral reuse, though the data rate is low at times.



# COMMDAR Challenges

- Radar Performance
  - Radar sensitivity
  - Suppression of clutter and strong targets
- Communications Performance
  - Data rate
  - Quality of Service
  - Network control
- High spectral re-use for both radar and communications
- Common MIMO waveforms for communications & radar
- Computational Complexity



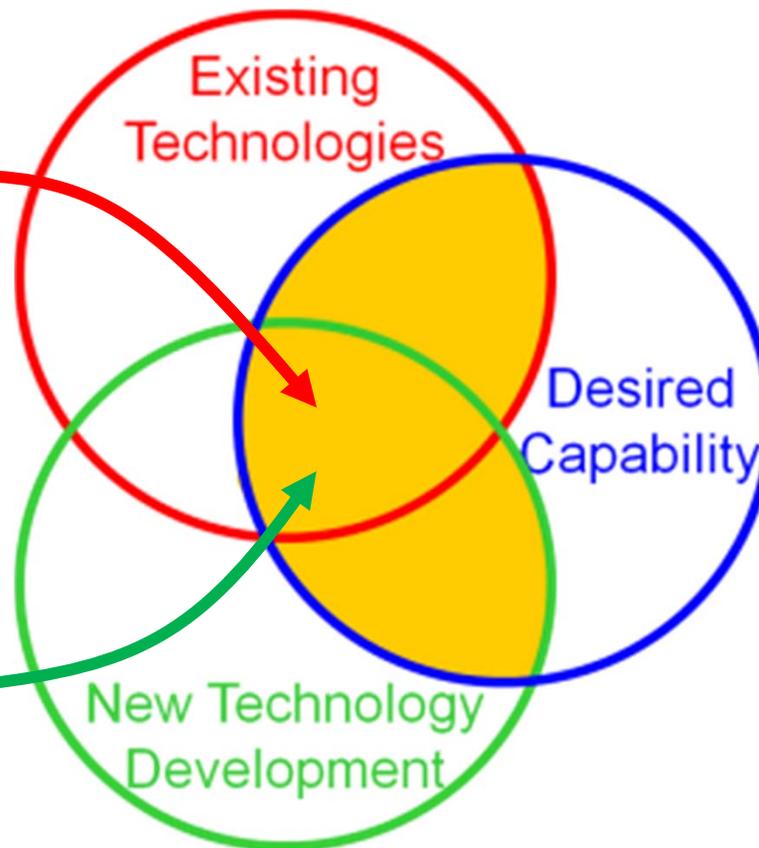
# Leveraged and New Technologies

## Existing Technologies Leveraged

- MIMO Radar.
- MIMO Communications.
- Statistic MIMO / Cooperative Radar.
- Ambiguity suppressing pulse compression (Passive Coherent Location).
- Radar resource management.
- Cellular resource management.
- Adaptive range-Doppler sidelobe suppression.
- LPD/LPI communications.
- Many existing radar, communications and EW sub-systems in common use

## New Technologies Being Developed

Jointly optimized comms. and radar waveform IMMW radar processor.  
Jointly optimized MIMO comms. and MIMO radar.  
Sidelobe Communications  
Jointly optimized resource management



COMMDAR is a new technology that blends existing and new component technologies